SIX DOLLARS

Electronic Business

MAY 15, 1989

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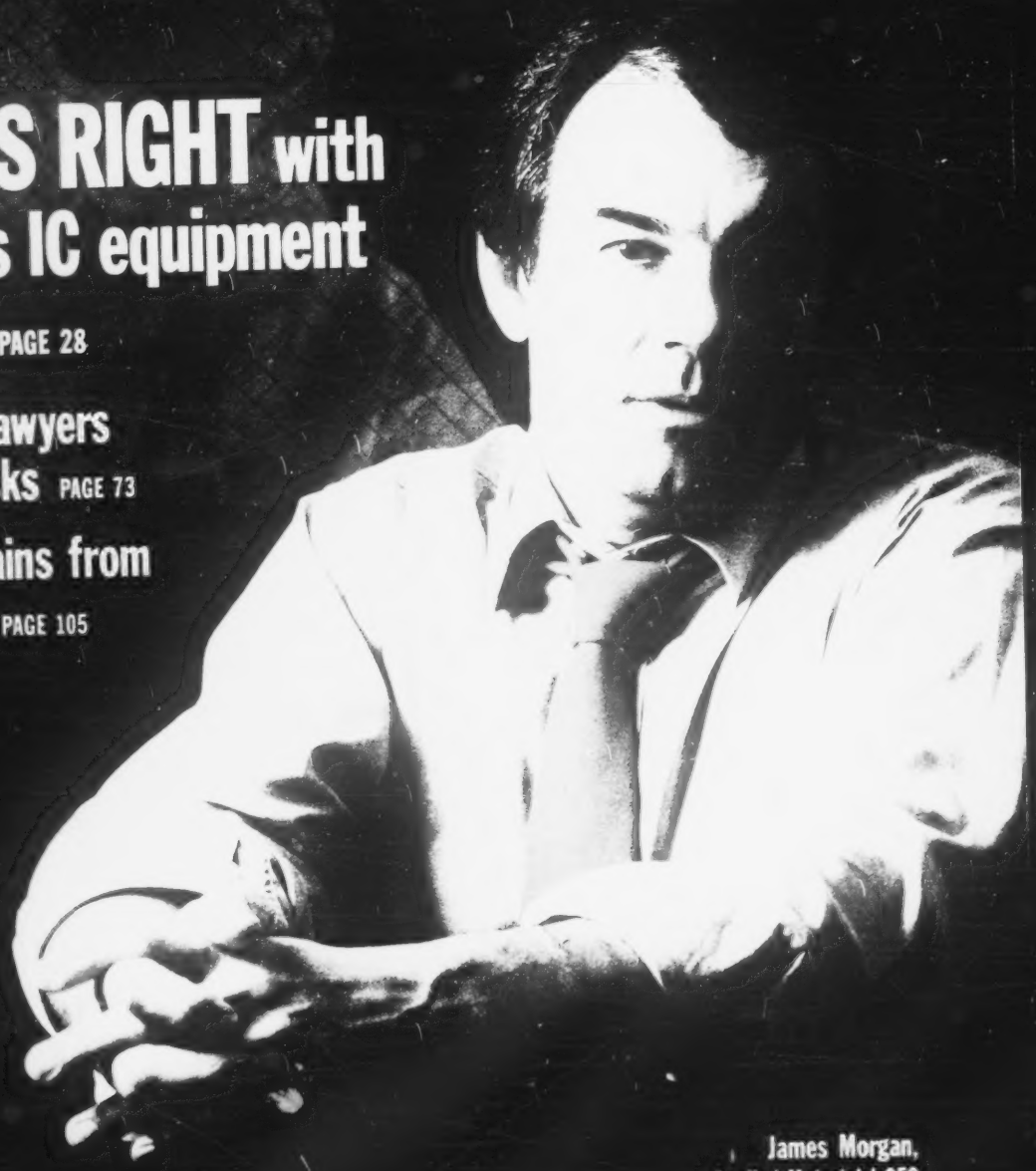

James Morgan, Applied Materials' CEO

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES—WORLDWIDE

VOL. 15, NO. 10

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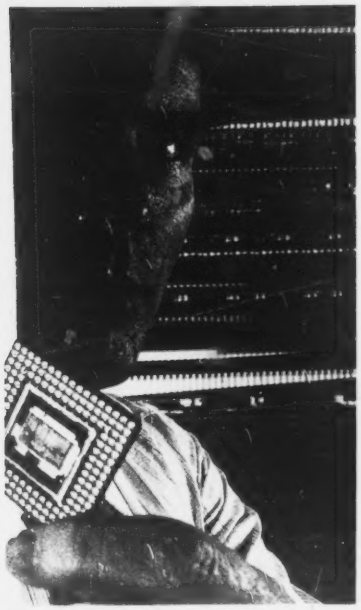
Cover photograph Christopher Springmann



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We're proud of our readability; it's an asset we have to protect in an age when information increasingly arrives as TV and tabloid chatter. Barb and Marvin are very capable custodians of that asset.

Marvin Greene, section editor

Barbara Jorgensen, copy editor

Wafer stepper woes

Ten years ago, U.S. firms ruled the world's IC fabs with their wafer steppers and other production equipment. Today, the leading vendors of chip-making equipment hail from Japan. What happened to the U.S. suppliers? As our cover line suggests, we feel the question isn't, "What's wrong with America's IC equipment makers?" but, "What's right with them?"

In our cover story, senior editor Valerie Rice explains how U.S. vendors dropped the ball, and how the rules of the game have changed. There's little doubt that it matters to North American chip makers. But can U.S. equipment vendors can now be much more than secondary players?

JOHN KERR, editor

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BPA ABP

What's right

with America's IC equipment makers?

By selling unreliable machines with dismal sales support, they've handed world leadership to Japan. Recent improvements by some U.S. vendors may not be enough to stop them from becoming niche players

BY VALERIE RICE

Ten years ago, U.S. semiconductor equipment companies were on top of the world, looking down on the rest of their competition. Today, they are looking up at the Japanese, who in 1988 captured the three top slots in worldwide market share, according to market research firm VLSI Research Inc.

The health of the equipment makers is inextricably linked to that of their customers, the semiconductor manufacturers. For every point of market share the U.S. semiconductor companies lose, their equipment suppliers lose a half-point, claims VLSI Research. But the reasons behind the malaise facing the equipment makers go deeper than that.

Many equipment companies acknowledge their own weaknesses, citing poor equipment performance, substandard service and general inertia as legitimate reasons for U.S. chip companies to look offshore. Now in a crisis situation, U.S. equipment makers are asking themselves why, and coming up with some uncomfortable answers.

The outlook is not entirely bleak. Equipment companies are now realizing they have to find a road back — and they need their U.S. customers to help them do it. For the first time, the two groups are starting to understand each other better, and the outlook for 1989 is becoming optimistic, for both market growth and fence mending.

That said, there are many who question whether the U.S. makers can ever climb all the way back. Former world leaders GCA Corp., Andover, Mass., have either dropped to the bottom of VLSI's top 10 list or fallen off completely. Still others are calling it quits entirely, witness that the U.S. equipment sector is actively consolidating: in late April, The Perkin-Elmer Corp. announced a major restructuring that put its IC gear unit on the block. And the U.S. share has begun to erode seriously. In 1982, U.S. firms had 62% of the $1.4 billion worldwide front-end equipment market (excluding test and assembly); by 1987, that share dropped to 45% of a $3.1 billion market, according to Dataquest Inc. Meanwhile, Japan went from 29% to 44%.

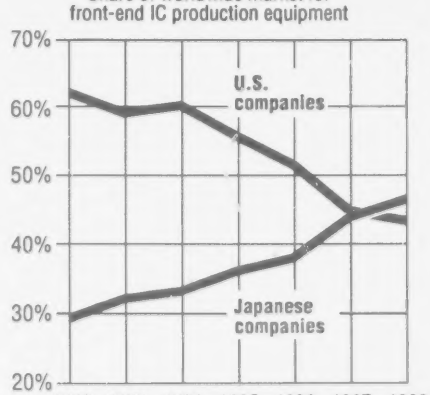
The bulk of the Japanese growth in the equipment market has come at the expense of the U.S. wafer stepper industry. Wafer steppers are a large chunk of the equipment market — currently about 32%, according to VLSI Research. The U.S. remains strong in areas such as ion implantation, epitaxy and sputtering.

But some industry experts fear that wafer steppers may be just the beginning for the Japanese, who have cranked up a high-caliber industry of their own in Japan, and may be looking to move into other U.S. equipment markets. However, the U.S. semiconductor makers have reason to fear dependence on the Japanese for production equipment.

"There is no way we can survive without an indigenous U.S. equipment base," declares Melbourne, Florida-based Harris Corp. semiconductor executive vice president Jon Cornell. "We would be history without it. If we can't get U.S. equipment and materials, we will be out of luck," stresses Cornell. Complete dependence on foreign production equipment could bring the U.S. semiconductor

U.S. suppliers' downhill slide

Share of worldwide market for front-end IC production equipment



Source: Dataquest Inc.

Christopher Springmann

industry to its knees, Cornell speculates, because the key process technologies would be in the hands of their main competitors.

Structural failure

The most obvious problem with the production equipment industry, and the most difficult to solve, is that it is not structured to be successful. The Semiconductor Equipment Materials Institute (SEMI) estimates there are 800 equipment companies in the United States, with average sales of $7 million per year, competing for a world market for front-end equipment that Dataquest says was worth only $4 billion in 1988. With purchasing patterns shifting toward larger, more stable companies and the market operating on an international basis, it is difficult to envision how small companies without extensive resources can survive.

Yet they *are* surviving. Despite the trend toward consolidation, the number of companies in the industry remains substantially the same, according to VLSI Research. Last year, however, some market research estimates suggest 26 companies merged, were acquired, or folded.

Regardless, the U.S. equipment industry is often its own worst enemy by aiming for short-term profits. Since U.S. investors frequently focus strongly on highly variable quarterly financial results, many U.S. production equipment makers often have difficulty in raising long-term capital to fund new development.

"There's too much focus on short-term results. You end up with companies that look good but have no staying power. . ."

Applied Materials' chairman and CEO James Morgan

"There's too much focus on short-term results," says Santa Clara, California-based Applied Materials Inc. chairman and CEO James Morgan, of the equipment industry as a whole. "You end up with companies that look good but have no staying power." Morgan refers to these companies as the "living dead."

So it's doubly difficult to compete with "Japan Inc." and its long-term mentality, notes Greg Reyes, president of American Semiconductor Equipment Technology Inc. (ASET), the Woodland Hills, Calif., wafer-stepper vendor. "By definition, we are behind the eight ball no matter what we do," he declares.

Those complaints U.S. chip makers have heard frequently. "The U.S. equipment vendors complain tremendously about how unfair things are," notes one.

Size is another major problem. With so many small companies, it is difficult to get the critical mass needed to make the sales. In fact, it is often impossible to get the resources needed just to survive the sales cycle, which can run upward of 18 months.

In this "very international marketplace today, you want to pick a vendor with worldwide presence," says Joe Grenier, director of semiconductor equipment and materials service at Dataquest. "Small companies have a difficult time getting worldwide presence, and if they don't get the sales, they don't have research and development money. In this industry, R&D money is critical."

But one U.S. company has been notably successful in

American Semiconductor Equipment Technology's president Greg Reyes: "By definition, we are behind the eight ball no matter what we do"

weathering the sales cycle. Applied Materials is one of the largest U.S. equipment suppliers, with fiscal 1988 revenue of $363 million. Most analysts credit CEO Morgan, a former venture capitalist, with the management expertise and foresight to survive — and actually prosper. Morgan says the secret was the philosophy that "... what we were doing transcended the ups and downs of the industry." In 1985, 1986 and early 1987, he says, Applied was just breaking even, but it still kept R&D spending as high as 18%. That amounted to some $30 million on R&D, according to Morgan.

The results speak for themselves. Applied has a well-diversified business with over half of its sales overseas, and is considered one of the best managed companies in the equipment industry.

But for small companies, the luxury of $30 million in R&D is impossible. "Say you're willing to invest 15% of your sales in R&D, and your sales are $20 million," explains Morgan. "That's $3 million, which means you do one product. Compare that to a company that's spending 10 times that. It's hard to compete with. It's hard to build up enough base to spend with."

"There are very few companies today that can afford the cost of development [on their own]," says Barry Cox, president and CEO of reticule maker Ateq Corp., in Beaverton, Ore. "Companies with less than $10 million in revenue won't be able to continue in the coming years," Cox says.

Customer or adversary?

The biggest complaint on both sides of the issue is that the industry is not structured like the Japanese model, which is held to be the yardstick by which all things are measured.

> **"There will be niches for U.S. IC gear makers"**
>
> **U.S. chip CEO**

In Japan, equipment companies do exactly what their customers tell them, VLSI Research president Dan Hutcheson says. And if the Japanese can find a locally made product that is acceptable, they do not go offshore. In the United States, there is very little communication, and the resulting products are often less than satisfactory. And U.S. chip companies buy a lot of foreign equipment — as much as 60% of the total installed base in some companies.

Reyes blames the U.S. chip customers. "These guys have no loyalty," he snaps. "If the U.S. would have operated on the same set of rules as the Japanese, we would not be in this situation today."

And although both sides are now talking more, the erosion continues. At Cypress Semiconductor Corp., San Jose, president T.J. Rodgers instituted a "Buy U.S." plan from the beginning, and is proud that 85% of his currently installed production equipment is U.S.-made. "We never buy foreign equipment unless we are forced to," he explains, "and it didn't happen at all in the first two or three years. But now it is happening more often. When we went to buy steppers, we ended up with Dutch steppers, because GCA was on the ropes. It's no longer a U.S. game." That's largely because U.S. vendors could not supply the most sophisticated models, adds Rodgers.

At Intel Corp., approximately 70% of the installed capital equipment is American, says Andrew Grove, president and CEO. "When we can, we try and buy American, but you have to be realistic," he stresses.

"U.S. companies have historically made dense devices but not addressed the manufacturing discipline," says Franc deWeeger, president of Advantage Production Technology, of Sunnyvale, Calif., a maker of chemical vapor deposition equipment. "The equipment industry has always been much maligned, but rightfully so in some cases. The equipment shipped often had poor uptime, and once it was shipped it was impossible to support."

Downtimes of 15% and more, even on wafer steppers, have not been unusual; customer support has often been deplorable. Bill Healey, senior vice president for operations at ASIC maker Silicon Systems Inc., Tustin, Calif., [now being acquired by TDK Corp.] cites examples of machines that could be down for a week, even after they'd gone through lengthy service discussions by phone with the vendor's technicians. "That's totally unacceptable," says Healey, who says he now looks for the vendor's technician the next day at worst.

There's even more urgency at SGS-Thomson Microelectronics America Inc., Scottsdale, Ariz., where the goal

Ed Glendinning

Finding offshore success: Applied Materials in Japan

Just when it looks like the Japanese are running roughshod over U.S. semiconductor equipment companies, enter Applied Materials Inc., Santa Clara, Calif.

With more than $135 million in sales in Japan in 1988 (out of total fiscal sales of $363 million), Applied is one of the largest U.S. suppliers to Japan.

And the company is living proof that the Japanese don't completely dominate the market.

"If Applied is doing so much business in Japan, that's some indication that the Japanese aren't doing that well," says former Applied senior vice president Robert Graham, now president and CEO of San Jose start-up Novellus Systems Inc.

Applied had an 18.3% share of the Japanese chemical vapor deposition market in 1988, according to market research firm Dataquest Inc., and a 57.7% market of the epitaxy market. Those figures are dramatically larger than the corresponding 1982 numbers of 11.8% and 33.5%, respectively.

If there is a formula to Applied's success, it is that chairman James Morgan saw the advantages of moving into foreign markets, like Japan, early on.

"There was not very much momentum going at Applied when I started in 1971," Morgan says. "The way I saw it, we needed to go direct into Japan, so we hired a local Japanese person. We focused on supporting him from wherever he needed support, so he could develop a Japanese company not totally dependent on indigenous resources."

Applied has been so successful in Japan that "we gained market share during a downturn," Morgan brags.

But it is still tough to break into Japan. Morgan notes that the Japanese "first preference is to buy within the family of companies. The second preference is to buy from another Japanese company and the third preference is to buy overseas." The key for Applied was knowing the market — and its customers. "We tried to get close to customers both Japanese and non-Japanese," he says. That's important, because Japanese companies want a product tailored to their needs, Morgan stresses. "If somebody local tailors it better then they are going to get the business."

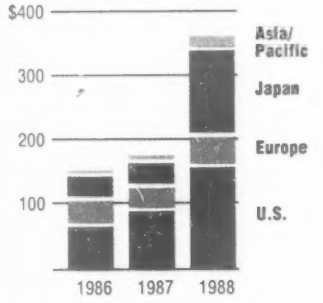
"You have to look like a Japanese company," he adds.

This understanding of service has been the backbone of Applied over the years, particularly in Japan, says Semiconductor Equipment and Materials Institute executive director William Reed. "The ability of Americans to respond to the need for service has been greatly misunderstood. Morgan understood service, but we still have some companies that are lax."

"Applied has partnered very well with their vendors and customers," says Dataquest's director of equipment and materials service Joe Grenier. "They have the best presence of any American company in Japan." □

Applied's Far East push

Applied Materials' fiscal year sales by region ($ millions)



Source: Applied Materials Inc.

is for equipment to be up and running again inside six hours.

And even Japan's detractors would agree that country's IC makers are strong in manufacturing. So, as semiconductor makers began to fall behind the Japanese, it seemed only natural to seek out Japanese equipment to help give them a competitive advantage, asserts VLSI's Hutcheson.

Ironically, however, the perception of Japanese equipment is often far better than the reality, at least according to Hutcheson, who conducts user preference surveys yearly. In 1987 (the most recent year for which data is available), Nikon Precision Inc. had a preference rating of 8.5, on a scale of 1 to 10, compared with U.S. competitor GCA, which had a 7.0. In terms of actual, measurable uptime, however, Nikon and GCA were tied at 93.2% in 1987.

Perception here is everything, according to Hutcheson. "There is prestige in owning Nikon," he claims, "and in the early days, like in 1985, people would still rate Japanese equiment better even though they didn't have any themselves. Usually it was because they owned a Nikon camera." So now that the Japanese have penetrated the market so extensively, Hutcheson is hoping that perception and reality will begin to merge.

For a long time, U.S. equipment companies and their semiconductor partners wouldn't talk to one another. Now a declining market situation has forced their hands, making uneasy partners of former adversaries. U.S. companies are trying to live down their reputations by asking their customers what they need.

"Fundamentally, the problem is that we don't understand each other's businesses," says GCA president Peter Simone. "We're starting to talk with each other. It's a lot better now than it used to be." As examples of the improvement at GCA, Simone cites regular user meetings, a user newsletter, and a growing awareness of increased support requirements.

And Simone says his production-driven strategy has worked. GCA has come back from the "living dead" over the past two years, and Simone stresses that the company is "now making production worthy equipment. We weren't really doing that before."

Despite some positive changes, some semiconductor customers remain skeptical. LSI Logic Corp. president George Wells asserts that the equipment industry refuses to face reality when told that their equipment must not break down — and must constantly improve. "The Japanese do a better job than the U.S. in keeping equipment up," he says. "It's sad but that's the problem. There are a fair number of people in the equipment business who have a real disbelief in the kind of performance requirements we ask of them." The bottom line, Wells believes, is that equipment companies "need to do better." In the meantime, LSI Logic gets 60% of its equipment from Japan.

Better equipment and better service are intertwined, according to Novellus Systems Inc. president Robert Graham, who previously spent years with Applied Materials. Graham says that production equipment from U.S. vendors "was de-

signed to demonstrate technology, rather than for inherent reliability."

"The Japanese are very intent on having things run all the time," says Graham, whose San Jose company manufactures chemical vapor deposition systems. "They lose face if their systems go down." Graham says that Japanese companies also put more emphasis on — and resources into — providing service. "The Americans just won't do it."

Perception and reality

VLSI's Hutcheson agrees. "In the early days, when U.S. companies were selling equipment in Japan and the market turned sour, they had to cut back on service. The Japanese vendors came in and hired those service technicians, and then the perception that Japanese equipment was better became reality."

One reason the Japanese do so well in service is their insistence on service contracts. Nikon, for example, requires that customers purchase a service contract or the company will not sell the machine, Hutcheson says. Thanks to that contract, Nikon has a repair time average of three hours, and an 8 out of 10 rating from customers for post-sales support. Nikon guarantees 93% uptime for its wafer steppers. In the United States, Nikon's service and technical support staff grew more than fourteenfold between 1984 and 1988.

In comparison, GCA, which Hutcheson estimates has only 30% to 40% of its customers with service contracts, has an average repair time response of 11 hours, and a rating of 5.7 out of 10.

Varian Associates Inc. is fighting back in this arena, by elevating customer service to "the same status as manufacturing," says semiconductor equipment group president Tony Jurvetson. "They report directly to me."

Good service applies just as much to the back end as to the front. Ideally, says Hans-P. Kürner, general manager of the U.S. arm of Swiss die and wire bonder maker ESEC SA, service would become obsolete, and one way to head in that direction is to reduce operator involvement by designing the machine around software. That way, recalibration by humans for different jobs is minimized, errors drop and set-up times improve.

The SEMI/Sematech solution

While equipment companies have been pushing for closer customer relationships with chip companies, the semiconductor companies have been doing some pushing of their own. Equally beleaguered by the Japanese, semiconductor companies have come to the realization, rather late in life, that an indigenous equipment industry is vital to their long-term health.

This intertwined relationship, and its implications for the future of the chip industry, was compelling enough to drive the semiconductor makers, after forming Sematech, the industry R&D consortium, to establish another R&D partnership with the equipment companies association, SEMI.

Hailed by both sides as a very positive step toward recovery of the U.S. industry, SEMI/Sematech is structured to provide technical access and small amounts of funding to equipment companies winning bids on research and development projects.

Once the products are developed, SEMI/Sematech bid winners are almost guaranteed a steady source of revenue — first from Sematech members, and then from any other company wanting access to designated state-of-the-art technology.

The problem, of course, is the risk of a "Rich get richer and the poor go out of business" syndrome, in which the bid winners will consistently be from larger companies less in need of an R&D boost.

Novellus' Graham believes that the intent of Sematech is good, but "the methodology is wrong. You don't want to give development money to large companies who already have it, but entrepreneurial companies with good ideas who need it."

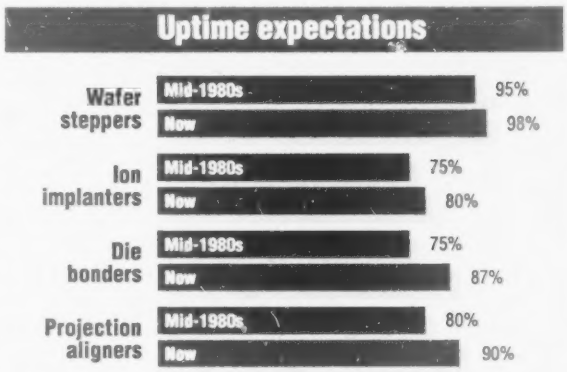
With the large number of players in the U.S. equipment market, it is impossible to satisfy all the companies, and SEMI/Sematech group president Sam Harrell does admit he runs the risk of playing "kingmaker."

GCA's Simone notes that "Sematech has to make choices. They can't buy everyone's equipment, so they are going to have to make difficult choices."

One equipment executive who declined to be named says his company is participating in SEMI/Sematech, but is not sure what good it can do. The large company mentality of the semiconductor members does not seem conducive to getting small equipment companies involved, the executive argues, so it may be a waste of his company's time, energy and money. The equipment people are not "standing up to the chip people," the executive says. "They are little more than errand boys for the semiconductor companies. How can unknown companies break in without some extra help?" the executive asks.

Sematech could also be too little, too late to help the equipment companies. The Joint European Submicron Silicon Initiative program in Europe is cited as one example, the funding of which (reportedly $4 billion total with $500 million just for equipment) makes Sematech's overall $200 million budget look small.

SEMI executive director William Reed is not sure what all the fuss is about. He argues that Sematech is just one possible solution to the U.S. equipment industry's woes, and notes that there are other options available.



While IC makers cite strong improvement in reliability from many of their U.S. equipment vendors, they add that the improvement is far from universal and often still not enough

The new purchasing order puts the squeeze on smaller vendors

Daniel Queyssac, president of Scottsdale, Arizona-based IC maker SGS-Thomson Microelectronics America Inc., recalls a previous job, a decade ago, when a major piece of IC production gear was talked about in an operations review and decided upon by the meeting leader with the immortal line: "Why don't you buy one?"

IC equipment vendors wish it were still that easy. But with more and more riding on the choice of process gear, semiconductor makers are turning their purchase decisions into committee activities — often headed by a top executive — and formalizing the buying process like never before.

Whereas Queyssac's former colleagues chose the gear in a couple of months, today it takes at least a six-person team over a year to choose something as crucial as a wafer stepper.

The new purchasing mode puts the squeeze on smaller vendors, and imposes tough new demands not only on the performance and reliability of their equipment but on their after-sales service.

"Buying has been made much more sophisticated," says Dataquest Inc. equipment and materials service director Joe Grenier. "Companies are not so willing to experiment with start-ups. They want proven companies."

Case in point is Bipolar Integrated Technology Inc., a Beaverton, Ore., maker of fast VLSI devices. In its earliest days — BIT was incorporated in 1983 — the company bought on cost, often buying from smaller IC gear makers. CEO Stephen Cooper admits to having been burned that way, so BIT's approach now is to go with proven vendors.

Others have firmed up their equipment sourcing by trimming the number of vendors. At Silicon Systems Inc., a Tustin, Calif., maker of ASICs, senior vice president of operations Bill Healey points out that his vendor list has been pared by over 30% in recent years to only those that can meet stringent after-sales service commitments.

Meanwhile, Healey now looks for his broken equipment to be working again inside eight hours — not the week that it could be out of action just five years ago.

Refined purchasing techniques are taking the place of the rush buy. Amid the turmoil of the mid-1980s IC downturn, National Semiconductor Corp., Santa Clara, Calif., opted to make the purchasing department fully responsible for equipment buys at any of its facilities, a move that offers more consistency and treats the vendor more like a partner than a servant.

"When you buy a major piece of equipment, it's not just a one-off deal. It's damn near like a marriage," says director of purchasing James Critzer.

These days, Critzer's department sets out a master agreement with potential vendors once early projections of IC demand have been met — not when the need for a machine is desperate. "Prenegotiating" outlines parameters like: guaranteed time to get the machine up and running; guaranteed minimum uptime; extended warranty; and spare parts prices over the life of the machine.

"We want a guaranteed seven-year supply of spares. You want to define these things up front," says Critzer. In the bad old days, he adds, the conventional purchase order never even touched the issue of uptime. Later, after a specific item of equipment has been decided upon, the request-for-proposal tackles actual engineering specs in detail. □

Buying IC gear today: Procrastination's out; prenegotiation's in

Typical prenegotiation points

- Guaranteed minimum uptime
- Guaranteed on-line time
- Extended warranty
- Guaranteed spare parts prices
- Guaranteed spares availability

"Sematech is only $200 million," he says. "There's an awful lot of money available for research and development out there. I don't know why people are so upset."

Reed says that DARPA (Defense Advanced Research Projects Agency) is funding $450 million in semiconductor device research alone. Combined with an estimated $650 million in R&D investment from SEMI members, and $700 million from semiconductor device vendors, he says $1.8 billion is being devoted to device research as a whole.

And there are opportunities for equipment companies to participate in the DARPA research projects. For example, the University of Southern Florida's Center for Microelectronic Design has an estimated $30 million research budget just for semiconductor equipment.

With funding sources and a few more receptive customers, equipment makers believe that they might be on the comeback trail to success, once again. And most semiconductor vendors would agree. "Things are getting better," says a National Semiconductor Corp. spokesman. "The equipment makers are making more of an effort to give us what we need." "We can compete right now in all other areas besides steppers," states Applied's Morgan, with the confidence of the successful.

SEMI's Reed would even argue that the United States is not dead and gone in steppers. Citing the potential of the high definition television market, Reed says "the market is wide open. There is no reason the U.S. can't come back in wafer steppers. HDTV will open up tremendous new avenues for our members. All the process equipment used to produce the chips is also needed to produce the flat panel displays."

Small stepper player ASET has had bottom-line benefits from high definition television — and other niches. "We put a lot of effort into it and sold three machines into the high definition television areas," Reyes says. "But in the volume stepper market we are having a tough time. We want to stick to niches rather than a frontal strategy."

The key to the U.S. comeback in the equipment business seems to be in focusing on the small battles, rather than the large wars. Like HDTV, other niche market opportunities will present themselves in new process technologies such as BiCMOS and gallium arsenide, and equipment companies must be prepared to anticipate these trends.

At GCA, Simone, when asked what he could have in this industry that he doesn't have now, says only "a big purchase order." Seriously, Simone believes that a renewal of the equipment business will only happen when his customers are willing to partner with him on products that might not be state of the art right now. "There

will be no long term without a short term," he says. "We have to first get to break even."

The verdict from many IC makers is mixed. There is widespread agreement that U.S. gear vendors have cleaned up their acts considerably on everything from equipment reliability to technician training. "Their whole attitude on service has really changed. They want to know about the problems. I haven't had to call [GCA president] Peter Simone in a long, long time, which is just head-and-shoulders above what it was," says James Critzer, director of purchasing at National Semiconductor Corp., Santa Clara, Calif.

It's the same story at SGS-Thomson. "Five or six years ago, you could not find any supplier that was willing to give a guarantee of 85% to 90% uptime. Now you have some suppliers who will guarantee at least 95%," says president Daniel Queyssac.

The key word there is "some." While users cite strong improvement from many of their U.S. vendors, they add that the improvement is far from universal and often still not enough. And that defines the future for the U.S. semiconductor production equipment industry. The bigger firms that have made the commitment to quality and service are already showing strong survival instincts, but many smaller players may never get the financial resources *and* provide enough value-added to get ahead.

But the road back will be tough. Says Stephen Cooper, CEO of fast VLSI firm Bipolar Integrated Technology: "I believe there will be niches for the U.S. IC production equipment makers. Overall, I have little hope that they will dominate again any time soon." □

South Korea offers a window of opportunity

If Japanese and U.S. markets appear too crowded, American IC equipment makers might look more closely at South Korea.

"Right now, Korea is buying more than Europe," says Dan Hutcheson, president of San Jose market research firm VLSI Research Inc.

With an IC production output that follows the curve from $2.3 billion in 1987 to $3.2 billion last year, and a government that is eager to head off the kind of friction that is souring U.S. trade relations with Japan, Korea holds plenty of promise — if its chip makers can be convinced that U.S. equipment and support is just as good as what they get from Japan.

Korea's semiconductor makers (chiefly Goldstar Semiconductor Co. Ltd., Samsung Electronics Co. Ltd., Hyundai Electronics Industries Co. Ltd. and Daewoo Electronics Co. Ltd., the IC operations of the four *chaebol*) last year spent about $370 million on production equipment, according to Domicity Ltd., a Toronto-based management consultancy that recently examined Korea's electronics base.

Among the bigger outlays listed during a recent Korean trade mission to the United States: Hyundai plans to spend about $60 million on furnaces, sputtering systems, etchers and other gear.

Korea *has* to buy from abroad — for now. "The Korean semiconductor equipment industry is very undeveloped. This is the greatest weakness of the Korean IC industry as a whole," explains Marc Brien, Domicity's director of research.

Until Korea gets up to speed, though, the market belongs to foreigners. Domicity, citing recent interviews with executives from Hyundai's plant in Ichon, about an hour's drive from Seoul, indicates that the balance may be in the favor of U.S. companies for now. Of Hyundai's overall base of IC equipment, 40% comes from Japan and 60% from the United States.

Specifically, 80% of the test equipment is sourced from Japanese firms Ando Electric and Advantest Corp., while all of the diffusion furnaces come from the United States and 80% of the wafer steppers are U.S.-made.

The window of opportunity is now — for two distinct reasons. First, notes Domicity, the Japanese are extremely hesitant to transfer technology to Korea's *chaebol*, and this lack of access appears to be reflected in buying patterns.

Second, much of Korea's nonproprietary process technology is American, and many of its purchases are made to fulfill OEM/foundry contracts — many of them with U.S. firms.

That's a bias that American equipment vendors are keen to capitalize on. Varian Associates Inc., Palo Alto, Calif., already sources a "substantial" portion of its IC equipment sales from Korea — the result of a presence there since 1975 and a joint venture that began in 1984. Varian also carries out some production there through its Varian Korea Ltd. operation. "We are getting double-digit orders from them," says Tony Jurvetson, president of the semiconductor equipment group.

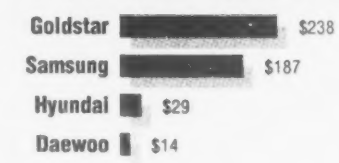
And GCA Corp. is actively eyeing opportunities to sell into South Korea's semiconductor manufacturers.

But an indication of Korean chip makers' future preferences may be seen in other comments gleaned by Domicity. Hyundai cites Nikon Corp. as the maker of the best steppers; although a little more expensive, the Nikon units run all day without the two-hour reset intervals required by the U.S. counterparts that Hyundai's Ichon plant runs.

Those reports confirm the general dissatisfaction of Korean chip makers with U.S. equipment support reported last year [ELECTRONIC BUSINESS, June 1, 1988]. □

Capital expenditures by Korean chip companies

Total 1988 semiconductor capital expenditures ($ millions)



Conversion rate: 748 won = $1

Source: Korea Economic Daily

Semiconductor equipment spending to grow steadily

The roller-coaster cycles of the past two decades are over for equipment suppliers as IC makers move ahead cautiously

BY MARK MEHLER

The boom-and-bust days are gone, at least for the present. 1988's $8.7 billion worldwide semiconductor equipment industry, after two decades on that bumpy road, is on a kinder-and-gentler slope this year.

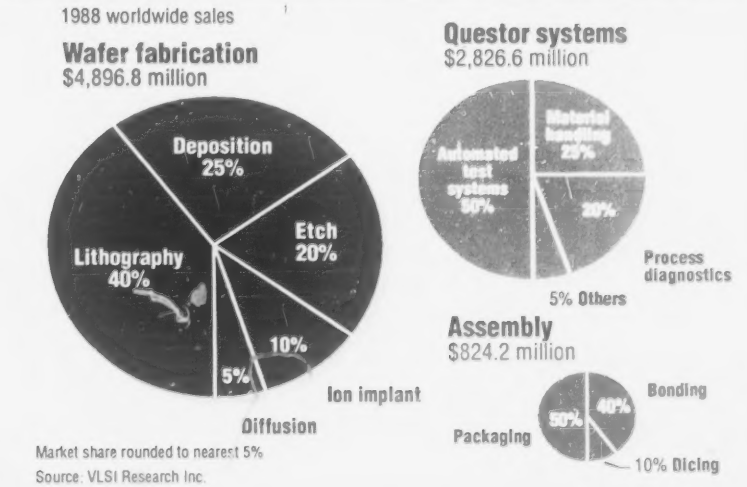
While the industry won't come close to matching its 55% to 60% annual growth rate last year, last fall's common wisdom — that an economic recession would drag the market in a negative direction — is now widely discounted. Market researchers, equipment vendors and IC makers now project anywhere from 8% to 13% growth in equipment revenue in 1989, and a solid 7% to 8% growth in bookings, a healthy harbinger for 1990.

"I think the equipment industry, the front-end and back-end systems houses, will have a reasonably good year," says Jim Feldhan, vice president of Scottsdale, Arizona-based In-Stat, a market research firm. "We've just raised our 1989 U.S. semiconductor sales forecast from flat to 2% growth to 13% growth, and worldwide shipments should be up more than that. There is still a lot of strength in the personal computer and telecom markets." Feldhan adds that Japanese semiconductor makers and the biggest U.S. capital spenders plan to bring on new memory, ASIC and microprocessor capacity over the next two years.

A minimum 8% to 10% worldwide equipment revenue growth in 1989 is forecast by Daniel Hutcheson of VLSI Research Inc., a San Jose firm that tracks the IC systems business. Hutcheson cites an economy that's steaming ahead, continued weakness in the dollar that is spurring U.S. OEM exports, and the rapid transition from bipolar to advanced CMOS and BiCMOS.

Similarly, a 12% increase in worldwide equipment shipments this year is predicted by Joe Grenier, director of semiconductor equipment and materials services at Dataquest Inc., a market researcher. However, Grenier considers this a pessimistic forecast ("anything under 20% annual growth in this market is disappointing"), but others take a more positive view. "Going back 16 years to the early 1970s," advises Pat Lamey, vice president and general manager of KLA Instruments Corp.'s wafer inspection division, the equipment industry's average annual growth, adjusted for inflation, is only 14% to 15%. Therefore, looking at it in that light, 10% or 12% growth this year, in a low inflation climate, doesn't look bad at all.

Semiconductor production equipment market



Market share rounded to nearest 5%
Source: VLSI Research Inc.

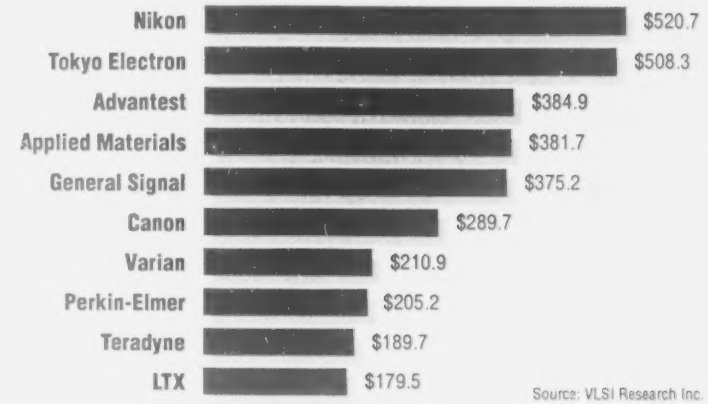
Can't match 1987-88

It would be unreasonable, say several observers, to expect the industry to continue its 1987-1988 growth spurt, the genesis of which was the failure of the U.S. and Japanese semiconductor manufacturers to make significant capital investments in 1985-1986. In late 1987, with the PC market taking off and demanding oodles of memory, the IC industry woke up to a manufacturing nightmare. Having made the transition from 256K to 1Mb memories, where yields were terrible, they couldn't supply either part in quantity. Hence, the capital equipment buying frenzy of last year.

But more spending is to come, James Bagley, chief operating officer of Applied Materials Inc., Santa Clara, Calif., a maker of etching, ion implantation and chemical vapor deposition systems, says Japanese memory houses, having ramped up

Top semiconductor production equipment makers

Estimated 1988 worldwide calendar year sales ($ millions)



Source: VLSI Research Inc.

1Mb production last year, soon will begin investing in 4Mb technology, and in high-performance CMOS processes for fine-line ASICs, microprocessors and advanced logic. Bagley says 4Mb equipment purchases, plus some "final line balancing" of 1Mb capacity, will raise Japanese merchant capital expenditures 15% above 1988 levels.

The U.S. picture is cloudier. The buying patterns are still very selective, but improved book-to-bill ratios earlier this year and plenty of activity on the part of the biggest IC producers — IBM, Motorola Inc. and Texas Instruments Inc. — are reasons for optimism. On the downside, other key players, such as Intel Corp., have delayed expansion programs because of bookings problems, and there remains an overall air of caution in the marketplace. Applied's Bagley estimates capital spending by U.S. IC makers to be up 5% to 10% in 1989.

Semiconductor manufacturers, for their part, are typically tight-lipped about their future purchasing plans. A spokesman at National Semiconductor Corp., in Santa Clara, Calif., for example, says that for the fiscal year ending in May 1989, National will spend approximately $250 million, 25% more than in fiscal 1988 and two-and-a-half times more than in 1987. All the spokesman would say about fiscal 1990 is: "We plan to spend less than current levels."

Those announcing new fabrication facilities over the next couple of years include: TI, a $250 million memory and ASIC plant in Italy under construction; Mitsubishi Electric Corp., a major facility in North Carolina; NEC Corp., an expansion of its Roseville, Calif., capacity; and Motorola, upgrade of a CMOS facility in Phoenix. Continued good news on the book-to-bill and interest rate front should bring additional announcements this year.

Stakes are higher

Nevertheless, in a more moderate growth environment, the emphasis naturally shifts from simply filling the pipeline to the ability to measure up to the rigorous demands of submicron CMOS wafer processing. VLSI Research's Hutcheson looks for the following types of companies to prosper at 0.8-micron to 1.0-micron technologies: vendors with the latest optical lithography tools and the latest generation chemical vapor deposition systems, for exposing and depositing metals in narrow spaces; diffusion furnace makers benefiting from the gradual shift from 6-inch to 8-inch wafers, which will require a major retrofit; and suppliers of advanced wafer linewidth and overlay measurement equipment. KLA's Lamey adds another requirement for doing business in the United States over the next two years: availability of flexible system software enabling ASIC suppliers to make rapid product changeovers.

The long-term view is that Japanese IC makers will continue outspending their American counterparts

Meanwhile, as higher capital costs have raised the stakes in the semiconductor market, IC makers have begun to reevaluate their equipment suppliers, putting much greater emphasis on vendor financial stability, service and support capabilities and reputation for reliability. Again, in a moderate growth climate, these trends, says Hutcheson, are likely to accelerate, resulting in more shaking out among the smaller equipment companies.

Longer term market observers see sustained growth for those equipment suppliers with the right tools and the financial wherewithal to service and support them. Prospects look particularly good outside the United States. The requirement by the European Community to produce chips in Europe and the emergence of an integrated European market in 1992 bode well for equipment vendors. William Reed, president of the Semiconductor Equipment and Materials Institute, says this rosy future could be glimpsed in the record turnout in March at the SEMICON/Europa equipment exposition in Zurich, Switzerland.

Also, the long-term view is that Japanese IC makers, which currently spend an average of 15% to 16% of revenue on capital equipment (vs. only 12% to 13% for U.S. semiconductor firms) will continue outspending their American counterparts. Kulicke & Soffa Industries Inc., Willow Grove, Pa., a major U.S. supplier of wire bonders, die bonders and other back-end chip assembly equipment, recently responded with a realignment of its Asia/Pacific engineering team, assigning a senior person to manage that key operation.

"It seems that they (Japanese, Korean, Taiwanese IC makers) have more confidence in the future and are willing to make a continued investment in new capacity," says Kulicke & Soffa president Don VanLuvanee, who adds that the U.S. equipment company's toughest competition now comes from such Japanese assembly systems makers as Disco and Shinkawa.

But more than marketing is required to compete with domestic makers in the Japanese and Pacific Rim marketplace. "I think every American company has to do a better job of engineering equipment for the Far East market," VanLuvanee says. □

Pyramid rights its course and now enjoys the party

This leading-edge computer company parlays Unix, focused marketing and conservative fiscal management into a 45% annual growth rate

BY RICK WHITING

While other companies were holding staid ballroom receptions at the UniForum trade show in San Francisco in March, Pyramid Technology Corp. rented a downtown disco and threw itself a Hollywood-style bash — complete with a Marilyn Monroe look-alike and search lights — to debut its new generation of computers.

Pyramid has always done things differently. And by zigging during the early 1980s when most computer vendors were zagging, the company finds itself at the leading edge of several industry trends: the growing acceptance of Unix and RISC for commercial applications; the move away from proprietary systems to "open" or standards-based products; and the evolution toward networks of desktop computers linked to database servers.

Pyramid's financial figures reflect the success of its visionary strategy. Sales grew from $17.5 million in the first quarter of fiscal 1988 to $24.5 million in the first quarter of fiscal 1989.

Pyramid's foundation, however, has not always been so rock-solid. Already weakened by what industry observers saw as a lack of market focus and an over-emphasis on "hot-box" technology, the Mountain View, Calif., company's growth stalled when a recession hit the computer industry in 1985-1986.

Today, with as much emphasis on tightly focused marketing and conservative fiscal management as on leading-edge technology, Pyramid is riding an annual growth rate of 45%. And the steps taken by Pyramid's management to right its course provide lessons for smaller companies looking to play in markets dominated by industry giants.

"I think they have a better feel for who they are and where they fit," says Jeanette Sill-Holeman, a senior analyst at InfoCorp, a Santa Clara, Calif., market research firm. "They're playing at the high end and that is where the growth is."

Jumped on Unix bandwagon

Founded in 1981 by software developer Rob Reagan-Kelley and Rolm Corp. sales executive Edward W. Dolinar, Pyramid's plan was to be among the first to jump aboard what was expected to be a Unix bandwagon. "Unix was not a product from any one vendor, but a demand pull from customers," says Dolinar, now Pyramid's executive vice president. (Reagan-Kelley left the company last year to pursue an advanced degree.)

Technological breakthroughs in the company's early days included the first superminicomputers to incorpo-

Kim Frazer

Pyramid chairman Richard Lussier, right, tapped Edward Scott Jr. as marketing vice president in an effort to make departments more accountable

rate RISC (reduced instruction set computer) technology (1983) and the first dual port of the AT&T and Berkeley Unix operating systems (1984). And Pyramid was among the first to recognize the industry evolution toward distributed computing.

Pyramid recorded a profit of nearly $3 million on sales of $33.9 million in fiscal 1985. In December of that year the company went public with an offering price of $16.75 per share.

But Pyramid found itself unprepared when the industry slump hit in late 1985. Although revenue continued to grow at a brisk 30% pace, expenditures for staffing and research and development were based on projections of much higher growth. Management was slow to rein in spending, and in fiscal 1986 the company reported a net loss of $1.7 million on sales of $43.6 million. Its stock fell to $4 per share. In late 1986, Pyramid's board of directors hired Richard Lussier as chairman, chief executive and president, replacing chief executive E. David Crockett. Lussier had served for three years as chief executive of computer equipment manufacturer Verticom Inc., and earlier was executive vice president at peripherals vendor Masstor Systems Corp.

Today, Lussier agrees that Pyramid lacked market focus in the days before he came on board and that management had not acted quickly enough when growth slowed. But he dismisses criticism that the company was trying to become a major supplier of general purpose computers and compete with IBM, Digital Equipment Corp. and others.

"There were no bad decisions; there was a lack of decisions," Lussier says. "This was actually a much more solid company than the picture that had been painted."

Shortly after becoming Pyramid's point man, Lussier concluded that the company's departmental operations — particularly sales — were operating too independently and without overall direction. "That's a dangerous way to manage," he says. Marketing was directed to work more closely with sales, research and development and other operations, and to play a stronger role in setting the company's direction.

To oversee that effort and strengthen the company's marketing operations, Lussier named Edward W. Scott Jr., then director of Sun Microsystems Inc.'s federal division, as marketing vice president.

Lussier also determined that Pyramid's sales organization was spread too thinly across too many markets. Sales efforts were revamped to concentrate on four markets: telecommunications, applications development, financial services and government.

Today, telecommunications accounts for 55% of Pyramid's U.S. sales, with the balance equally split between the other areas. From the first quarter of fiscal 1988 to the first quarter of fiscal 1989 alone, revenue per salesperson skyrocketed from $1.1 million to $2.4 million.

Moving to bring R&D expenses under control, Lussier ruled that only such giants as IBM and DEC can afford the luxury of "confrontational project development" and canceled one of two competing development projects. "Sometimes you just have to tell people 'no,' on things like R&D," he says.

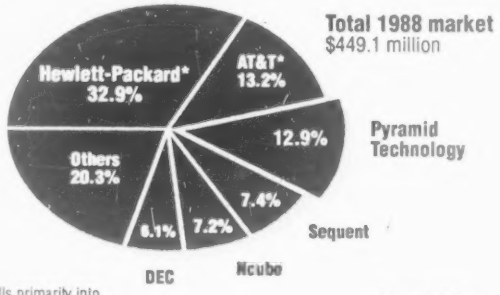
"While some people prefer to throw all caution to the wind and grow for growth's sake — and some companies like Sun have pulled it off quite successfully — that's not my nature," he continues. Using the project development decision as an example, Lussier describes his strategy for building Pyramid as "pay as you go."

That becomes clear to anyone reading Pyramid's balance sheet. The company has no long-term debt and a $20 million cash reserve. "We are very, very clean," Lussier says. "We cannot be caught by any big surprises, financially."

Targeting the high end of the commercial Unix market, Pyramid has opted not to compete in the fractured low end of that arena, where AT&T's 3B line, NCR Corp.'s Tower line and others battle for market share. "We would not be interested in a mom and pop store with $1 million in revenue," Scott says, adding that the average Pyramid customer makes $2 million in purchases the first year. "We want people who want large systems."

1988 U.S. midrange Unix market

U.S. Unix market for commercial and noncommercial systems with average selling price of $200,000 to $350,000



* Sells primarily into noncommercial markets

Source: InfoCorp

"Dominating the market"

Although Pyramid ranks third in the U.S. among vendors of the Unix-based systems with an average selling price of $200,000 to $350,000, the company controls more than 50% of the U.S. commercial Unix market for systems in that price range, according to InfoCorp. "So we're really holding our own, really dominating the market we're in," Scott says.

Lussier says that Pyramid's competition comes from other vendors of high-end Unix systems, such as Sequent Computer Systems Inc.'s Symmetry and Balance lines, Hewlett-Packard Co.'s Spectrum line, and Computer Console Inc.'s Power series.

Sequent also targets the government and applications sectors, while Pyramid most often sees CCI in the telecommunications market. But while the product positioning and distribution strategies of Sequent and

Lussier describes his strategy for building Pyramid as "pay as you go"

CCI are not vastly different from Pyramid's, "the Unix market is extremely large and Pyramid sees them in less than half of its competitive situations," concludes a 1988 Montgomery Securities report.

But with both DEC and IBM exhibiting a born-again zeal over Unix, Pyramid will likely find itself competing more often with those and other heavyweights. "There are a lot of big boys who have decided that this is an important market," Scott acknowledges. However, Scott says Pyramid computers are bought by DEC and IBM customers to use as servers within existing networks.

Pyramid's installed base now exceeds 1,600 systems worldwide, and its customers include Hughes Aircraft Co., Metropolitan Life Insurance Co., TRW Inc., the regional Bell operating companies and the Electronic Data Systems division of General Motors Corp.

A common theme pervades among Pyramid's customers: Many decided long ago to abandon proprietary systems in favor of Unix. And after evaluating platforms from a number of vendors, they settled on Pyramid.

"We could go out and run the same identical software on all the platforms and get our own benchmarks," says Robert Handel, executive director at the New York City law firm of Davis Polk and Wardwell. "And Pyramid was clearly far ahead of DEC, IBM, Gould and all the others," in price/performance. One of Pyramid's earliest customers, the firm scrapped its aging DEC PDP-11s in 1983 and now owns 10 Pyramid computers.

DHL Worldwide Express Corp. began buying Pyramid computers five years ago and now has some 18 systems, according to information services vice president William Pigott. The Redwood City, Calif., shipping company, which uses the systems for package tracking, billing and office automation, spends between $2 million and $2.5 million on new Pyramid computers each year.

Several users cite Pyramid's in-house service operation as another reason for buying from the company. Pigott says Pyramid worked "hand in glove" with DHL to incorporate its computers into the shipping company's proprietary network. Twenty percent of Pyramid's workers are employed in the company's service operations, which Lussier describes as "profitable in its own right."

Pyramid's building sales

Source: Pyramid Technology Corp.

Software alliances

With database software a critical part of distributed computing, Pyramid has formed alliances with big-name database software vendors, including Informix Software Inc., Oracle Corp., Relational Technology Inc., and Sybase Inc., and markets those companies' products with its computers.

International sales account for 50% of Pyramid's revenue. The company uses direct sales in Britain and relies on OEMs and distributors to cover the rest of the globe: Tatung Corp. in Taiwan, the Hyundai Group in Korea, and Sharp Corp. in Japan, among others.

Expectations for 1989 sales range from $97 million to more than $112 million

The largest OEM to date has been Nixdorf Computer AG of West Germany, which resells Pyramid's 9000 line as the Targon 35 and also holds a 7.5% equity stake in Pyramid. In fiscal 1987 Nixdorf accounted for more than 26%, or some $14 million, of Pyramid's sales.

In early 1988, however, Nixdorf exercised an option to make the computers itself, cutting its share of Pyramid's revenue to about $10 million, or 12.5%. Analysts expect those numbers to drop further this year to about $6 million or just over 5% of the company's sales, despite expectations that Nixdorf will market Pyramid's newest generation of computers.

Nonetheless, Pyramid's growth has continued with income of $[illegible] million on sales of $54.1 million in fiscal 1987, and income of $8.7 million on sales of $79.8 million in 1988. Analysts' expectations for 1989 sales range from $97 million to more than $112 million.

Financing growth is, in fact, Pyramid's biggest challenge. The company has an unsecured $15 million line of credit with Bank of America, but Lussier hopes to avoid using debt for growth for at least a year. "That's the major challenge facing the company," he says. "Finding a way to fund things that won't pay off until tomorrow."

Company executives hint that the answer may be a corporate alliance with a major company, possibly a R&D partnership or an equity investment along the lines of last year's AT&T investment in Sun. Lussier will not say more, other than to emphasize that Pyramid is not looking to be acquired.

"Clearly they would make a very attractive partner for a large company looking to get into the commercial Unix market," says Jeffry Canin, a San Francisco-based independent analyst. Such a partnership would help resolve another problem facing Pyramid: name recognition. "There are still a lot of people out there who say, 'Pyramid who?'" says InfoCorp's Sill-Holeman.

Pyramid renewed its vows to the high end of the Unix market at UniForum by unveiling the Corporate MIServer line, offering a performance range of 50 MIPS to 140 MIPS with price tags of $600,000 to $2 million. (The line is object code-compatible with the older 9000 series, which has a performance range of 3.5 MIPS to 25 MIPS and a price range of $90,000 to $900,000).

Pyramid debuted the MIServer under the slogan "A Star is Born" — hence the Hollywood theme at the UniForum party. While Pyramid itself has been performing for some eight years, the company is only now facing the big time and taking its place in the spotlight. □

Quarter-inch drive makers move to ward off rivals

New data backup solutions such as digital audio tape have drive makers scrambling to increase capacity. At stake is their 82% share of the market

BY JOHN McCREADIE

Despite the threat of new competing backup technologies such as digital audio tape (DAT) and erasable optical storage, the quarter-inch tape drive still reigns in the data backup marketplace.

The industry — getting stronger as PC hard disk drive capacities increase — commands a 82% share of the data backup market, according to Dataquest Inc., a San Jose market research firm. Through consolidation, tape drive makers are looking for new channels to capture the business of an estimated 12 million personal computers and workstations still without data backup systems.

Tape drives already have an installed base of more than 3 million units, but "less than 15% of PC users" are using them, says industry analyst J. Michael Casey at InfoCorp in Santa Clara, Calif. Worldwide, analysts say, there are some 38 quarter-inch tape drive manufacturers supplying a projected 1.2 million units this year.

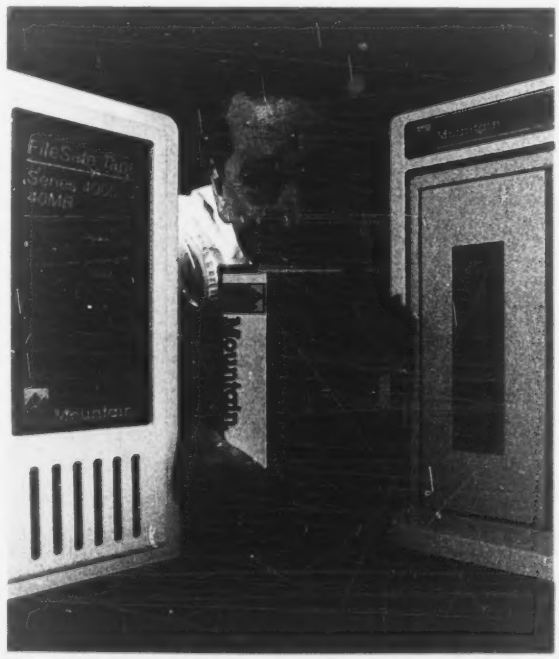
Overall, manufacturers enjoyed a robust 18% average unit growth rate in 1988, but analysts expect that to taper off this year to about 8% or 9%. In the next few years, revenue growth for the market is expected to increase modestly. Dataquest reports worldwide factory revenue will reach $564 million by 1990, up 9% from 1988 revenue of $519 million.

And 1990 will be the first year 3.5-inch form-factor drives will outsell 5.25-inch drives, by about 61,000 units, Dataquest estimates. In 1992 projected sales of 2.1 million 3.5-inch drives will far outdistance the 600,000 5.25-inch models expected to be sold then. Dataquest analyst Hinda L. Chalew says the projections mirror the hard disk drive industry by about 18 months, giving the industry the advantage of forecasting demand via disk drive sales.

"This plugs us in to what our next generation will be," says Whitney G. Lynn, senior vice president for peripheral products for Mountain Computer Inc. in Campbell, Calif.

As the industry matures, some well-established quarter-inch tape drive makers, including Archive Corp. and Cipher Data Products Inc., are foregoing development of their own 3.5-inch products and instead are acquiring smaller, often retail-oriented companies. Some observers say this trend will continue as the market tightens.

San Diego-based Cipher, strong in OEM business with 1988 revenue of $185 million, acquired Ann Arbor, Michigan-based Irwin Magnetic Systems Inc. in March for $74 million. Irwin had 1988 sales of $49 million and a tidy net profit of $1.5 million. Together, the two companies have an estimated 1988 market share of 22%, according to market research company Freeman Associates Inc. of Santa Barbara, Calif.



Mountain Computer's Whitney Lynn says rising projections for 3.5-inch form-factor drives "plugs us in to our next generation"

Jim Cameron

Similarly, Archive of Costa Mesa, Calif., acquired Maynard Electronics Inc. of Casselberry, Fla., recently for an undisclosed amount, a union designed to give Archive increased retail and VAR channels.

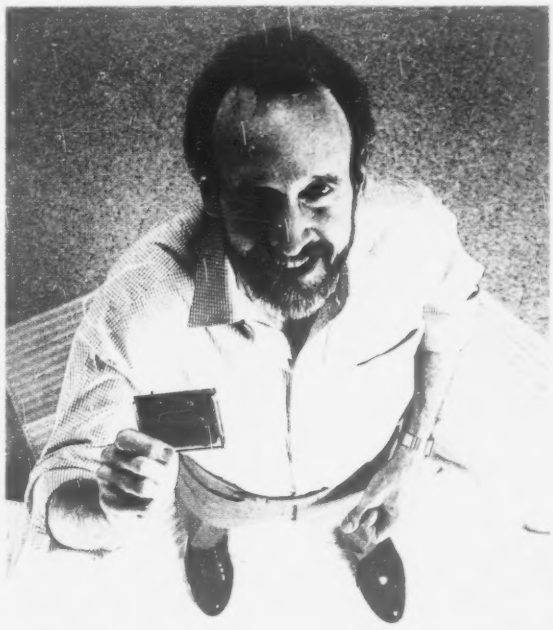
And Mountain Computer recently announced its aggressive expansion beyond its traditional strength in distribution and reseller channels to sell to OEMs.

As of last October, Mountain closed a $45 million cash deal to be acquired by Nakamichi Corp., a Japanese company often described as the Rolls Royce in consumer stereo equipment. The acquisition, in turn, gives the tape drive maker an important strategic alliance with California Peripherals

Inc. of Torrance, Calif., a $21 million OEM distributor for Nakamichi's computer peripheral products.

Early last year, CMS Enhancements Inc. of Tustin, Calif., purchased manufacturing equipment and engineering assets of the Singapore-based Data Storage Products Division of North Atlantic Industries Inc. for an undisclosed amount.

One large half-inch tape OEM sees consolidation of the quarter-inch tape industry as an attempt to stay competitive with emerging higher capacity backup solutions, such as DAT. "OEMs are moving away from quarter-inch," according to Bob N. Morris, director for product marketing for Fujitsu America Inc. in San Jose. "[Quarter-inch manufacturers] need to expand their channels to get to the end user to sell drives."



Colorado Memory Systems' William Beierwaltes: Data compression software "can double and triple our capacity"

The fear of competing alternatives for tape backup and archiving continues to push manufacturers to increase product capacities rapidly and transfer rates to keep quarter-inch products attractive.

Meanwhile, the latest threat is from 20-megabyte floppy disks, expected to be seen in production quantities later this year. By 1991, market researcher James N. Porter of Disk/Trend Inc. of Mountain View, Calif., projects worldwide shipments of high-performance floppies (10MB and 20MB) to reach 750,000 units for an estimated revenue of $174 million.

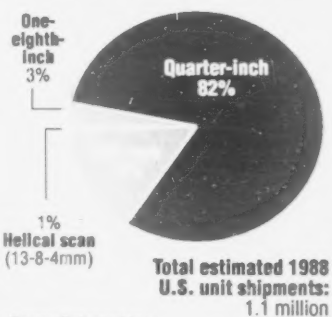
But what tape drive customers seek most are lower cost and greater capacity, analysts say. Responding to those demands, quarter-inch makers have been forced to increase capacities. The strongest growth area is in 120MB and 150MB capacity drives, the newest capacity threshold, with projected 1989 shipments of 306,000 units, says Freeman Associates.

Sales of 40MB and 60MB drives still remain steady, projected to drop 19% from 1988 shipments, says Freeman Associates. By 1990 and 1991, 320MB drives are expected to be in full production with 1.3-gigabyte drives beginning to appear.

Tim Davis

Increasing the capacities of tape drives will be aided by advances in both hardware and software data compression techniques and by improvements in the physical capacity of tape cartridges. For example, 3M Co. is now shipping limited quantities of a cartridge packed with 1,000 feet instead of the traditional 600 feet. Meanwhile, the new tape can increase drive capacity from 320MB to more than 500MB without significant cost increase.

1988 U.S. tape market



Source: Dataquest Inc.

On the software side, Colorado Memory Systems Inc. of Longmont, Colo., is offering a tape drive that uses data compression software. "We can double and triple our capacity for not very much money," notes William T. Beierwaltes, president of Colorado Memory Systems. With the software and longer length cartridges added to the company's 40MB drive, capacity jumps to about 120MB at a total cost of $600. Colorado Memory Systems' standard 150MB drive sells for $1,400.

Some tape drive makers are investigating a two-chip data compression set from Stac Electronics, a small Pasadena, Calif., semiconductor company. The chips, when installed in quarter-inch tape drive controllers, can compress data two or three times. Stac president Gary W. Clow reports receiving a large number of orders from unspecified quarter-inch companies.

Meanwhile, some quarter-inch manufacturers such as Wangtek Inc. and Archive are hoping to complement their current storage lines by adding DAT products. Uncertain of the drives' potential for success, some manufacturers fear DAT mechanisms are too dependent on consumer volumes and that the technology will not move fast enough for the computing market.

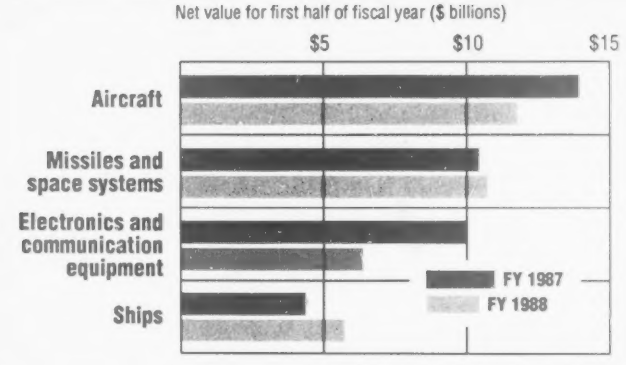
Yet drive makers are keen enough to be ready if customers demand the newer, higher capacity digital tapes. "To be quite frank, it may keep us in the next potential market of tape technology," says Richard A. Peters, Archive's director for marketing.

Ultimately, the quarter-inch market appears to be formidable enough to counter the threat of DAT or mega-floppies, largely because of one constant: its strong installed base. "What users want today is something a little more mundane than all the flash of digital audio tape and optical drives," according to Cipher's quarter-inch product manager Kim Kelly. □

Communication equipment — inventory-to-shipments

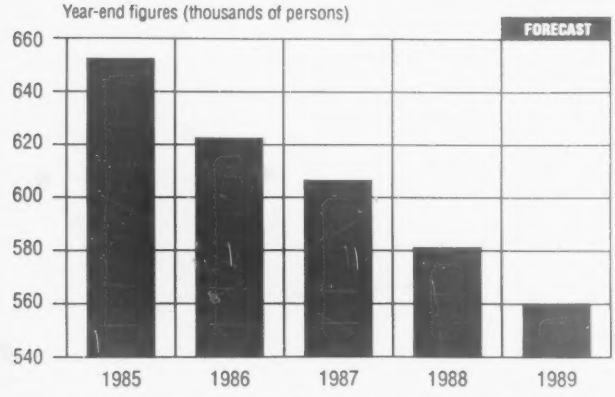
Data source: U.S. Commerce Department; Forecast: Cahners Economics

DOD prime contract awards



Data source: U.S. Department of Defense

Communication equipment employment



Data source: U.S. Department of Labor; Forecast: Cahners Economics

Cutbacks seen on communication gear

United States-based manufacturers of communication equipment are cutting back on production. Although output of communication equipment came back 2.5% from December to January, December's production represented a precipitous decline from the month before. So, even with the one-month rise at the beginning of this year, the production index for January was the second lowest monthly level since June 1988 and was 5% below January of 1988. A squeeze in the defense sector and the general economic slowdown affecting the commercial sector mean a downward production trend through the better part of 1989.

Inventories are petering out in the defense market and rising just slowly in the commercial sector, but for the most part, management is not allowing any involuntary buildup of inventory. As of month-end January, inventory of $16 billion declined 2.5% from its year-ago level. This action has trimmed inventory-to-shipments ratios to a range of 2.4 to 2.5, down from a monthly ratio of over 3.0 at the beginning of 1986.

Equipment contracts dwindle

Cutbacks in government sector buying, particularly in the military, are having an impact on the communication equipment market. According to a Department of Defense report, DOD prime contract awards for electronics and communication equipment, not dedicated to a single weapons system, totaled $6.38 billion in the first half of fiscal year 1988, a drop of 36% compared with awards of $10.03 billion in the first half of fiscal year 1987. Even on a share basis, prime contract awards for communication equipment have dwindled. In the first half of fiscal 1987, awards for electronics and communication equipment accounted for 16.4% of total DOD procurement, while in the first six months of fiscal 1988 they represented only 11.4%.

Not surprisingly, employment in the communication equipment industry has shrunk significantly. At the end of last year, the industry employed 582,200 persons, down from 652,000 persons just three years before. Employment is forecast to sink another 4%, ending 1989 at around 560,760 persons.

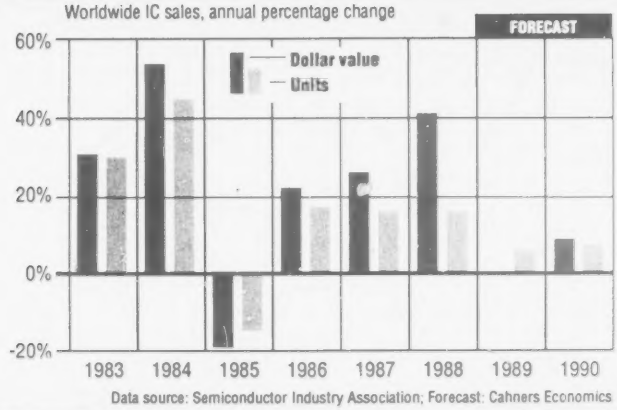
MADELINE FRANCHI

(Communication equipment will appear again in the August 21 issue of ELECTRONIC BUSINESS.)

Semiconductor sales slipping in 1989...

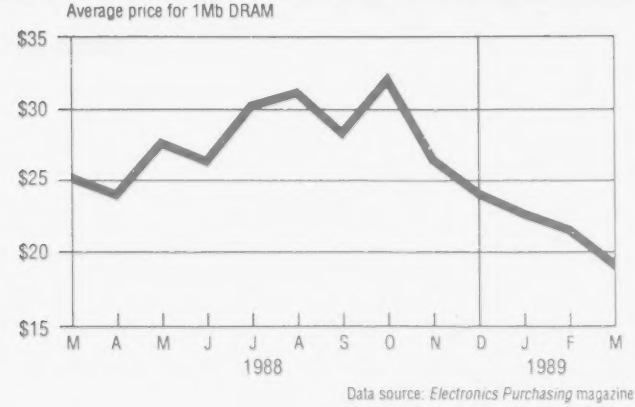
Data source: Semiconductor Industry Association; Forecast: Cahners Economics

...but unit sales are growing...



Data source: Semiconductor Industry Association; Forecast: Cahners Economics

...because memory prices are falling



Data source: *Electronics Purchasing* magazine

Knowing IC prices helps in sales forecasts

As inevitably as winter follows autumn, the semiconductor industry appears poised for a slowdown in 1989. Sales of semiconductors in the United States and Canada totaled an estimated $3.4 billion in the first quarter of this year, just 15% above a year ago. While that 15% growth may seem impressive, it's down from 28% year-to-year growth in the final quarter of 1988.

Slowing growth has a lot of semiconductor companies worried about 1989 and 1990. The last time sales began slipping they ended up tumbling 30% by the end of 1985. Cahners Economics' forecast tells a different story for 1989. By the end of this year, Cahners expects U.S. sales to drop only 3% and then to rise 7% again in 1990.

Unit sales doing better

Almost all sales forecasts we talk about for the semiconductor industry are based on current dollar-valued sales. In other words, the figures are not adjusted for the inflationary effects of rising prices.

Unit sales of integrated circuits will grow in 1989 even though dollar sales are falling. That's because prices are likely to drop in 1989 after the sharp price increases of the previous year. Falling prices bring down the sales volume figures when measured in dollars, while the actual numbers of units produced and sold will be doing much better.

According to a monthly survey by our sister publication, *Electronics Purchasing*, prices for the device that created a purchaser's nightmare last year — the DRAM — fell fast earlier this year. After surging to an average $9.45 last October, prices for the 256K DRAM had dropped to $6.73 by this past March. Prices for the more advanced 1-megabit device have declined from $31.80 to $19.32 over the same period.

Prices will most likely continue to fall as new fabrication plants come on line and as yields for the 1Mb DRAM continue to improve. And as long as yields improve, falling prices are not necessarily bad for semiconductor makers.

Still, demand for semiconductors, at least in the United States, won't be growing as fast in 1989 as last year. But who says a period of stability will be so tough? Anyway, look out 1990 and 1991, because semiconductor growth will be coming on strong then.

ELIZABETH B. BAATZ

(Semiconductors will appear again in the August 21 issue of ELECTRONIC BUSINESS.)